REMARKS

Claims 1 – 10 and 12 are pending in this application.

CLAIM REJECTIONS – 35 USC §103

Claims 1 and 3 have been rejected under 35 USC 103(a) as being unpatentable over Lemelson (US Patent No. 5,871,805, hereinafter "Lemelson"). This rejection is respectfully traversed. Applicant welcomes the citation of Lemelson. Lemelson hopefully will provide a good contrast to enable Applicant to show what a great advance in the art the current invention is. Lemelson is one of a series of idea patents that has given rise to substantial controversy within the patent community. Lemelson discloses the use of optical imaging sensors in combination with computers to control vapor deposition processes to optimize the coating of the substrate (Lemelson Abstract; col. 1, lines 5 – 10; and col. 4, lines 24 – 34). The output of the imaging sensor is processed into a computer model of the deposition process and used to generate "feedback signals" to adjust key operating conditions of the coating process, which may include temperature, pressure, reactant flow rates and composition, and the like (col. 4, line 52 – col. 5, line 2).

In contrast, the accumulation sensor in Applicant's disclosure is being used inside a chemical vapor source chamber system for generating vapors from solid or liquid chemical. No growth of any film occurs in the source chamber. Instead, condensation of chemical vapors on the accumulation sensor is used to determine whether the vapor pressure of the chemical in the chemical source chamber is higher or lower than the vapor pressure at the condensation temperature corresponding to the temperature of the accumulation sensor. This condensation temperature is what is often referred to as the "dew point", and the vapor pressure at the dew point is referred to as the "dew point vapor pressure". This accumulation is fed back to a vaporizer to control the vapor pressure of the chemical at about the dew point vapor pressure. Applicant has now amended the claims to reflect this distinction to make a clear-cut case that the disclosure relates to a chemical source system, and that the accumulation sensor is used to sense condensation of liquid or solid chemical (see, i.e., disclosure col. 34, lines 2 – 28, and col. 36, line 32 – col. 37, line 1).

Unlike the application of Lemelson, the accumulation sensor in this disclosure can be stripped of the layer of condensed chemical that accumulated on the sensor once the chemical pressure falls below the dew point vapor pressure (see, i.e., disclosure col. 35, lines 3 – 10). Accordingly, the chemical pressure can be controlled with precision. The apparatus as stated in the claims teaches that the solid or liquid chemicals are contained in a heatable chemical source holder (e.g., a crucible, a Knudsen cell, and the like) that is contained within the chemical source chamber, the accumulation sensor is accurately temperature controlled, and there is absolutely no line of sight from the crucible to the accumulation sensor. The method taught in Applicant's disclosure provides the set point for the desired controlled chemical vapor pressure by determining the temperature of the accumulation sensor to be the condensation (dew point) temperature for the desired vapor pressure and by controlling the heating power to the chemical source holder such that the accumulation sensor is sensing as close as it is practically possible to zero accumulation. At zero accumulation, the vapor pressure of the chemical is exactly the dew point pressure since, in the absence of line-of-sight, the accumulation on the sensor is a true representation of the condensation processes due to the vapor-solid (if the chemical is solid) or vapor-liquid (if the chemical is liquid) equilibrium (see, i.e., disclosure col. 34, lines 2 – 28).

Not only does this disclosure teach an apparatus and method that are entirely orthogonal to the apparatus and method described by Lemelson, there is also no computer models given in the disclosure. Not a single temperature, pressure, or other parameter are being modeled in real time, which is really all that Lemelson has added to the prior art. The point to be made here is that everything in the Lemelson disclosure, except the combination of the optical imaging sensor and the computer model, is conventional. Applicant has amended the claims to make the distinction from Lemelson crystal clear.

Lemelson is using the accumulation sensor in the conventional way of controlling the deposition rate and the growth of film. In contrast, this invention is using the accumulation sensor to control the vapor pressure of a chemical within a chemical source. The accumulation on the sensor is not the growth of a film but rather the condensation of the source chemicals when/if the vapor pressure of the chemical inside the source exceeds the dew point vapor pressure that relates to the temperature at which the accumulation sensor is maintained. Ideally, this accumulation, as taught in

this invention, is maintained at the minimum which results in the desired outcome of controlling the vapor pressure at approximately the dew point. This design is particularly advantageous to applications, such as Atomic Layer Deposition, that use the chemical in a non-steady state mode wherein when a large amount of chemical is being drawn out of the source, the source has to vaporize more chemical quickly, otherwise the source may not have the same performance next time the chemical is being drawn due to reduced vapor pressure (see, i.e., disclosure col. 34, line 28 – col. 35, line 7). There are two ways to get around this problem. The first one is to make the source very large such that even the largest draw of chemical does not substantially deplete the source. This "solution" is disadvantageous and generally not practical. The second method, as taught in this disclosure, is novel and provides a quick sensing that the vapor pressure falls below set-point and a way to substantially boost vaporization quickly to replenish the source after a large draw of chemical. To achieve that purpose, the apparatus and methods that are taught in the invention, including but not limited to, a sensor having no "line-of-sight", sensor temperature controlled substantially at the condensation temperature for the desired vapor pressure, and the control of the chemical heating in response to condensation/accumulation on surface of the sensor, are novel and not in Lemelson or any of the other references.

The accumulation sensor of Lemelson (the optical sensor) conventionally measures the coating thickness on the substrate or a blank positioned near the substrate (Lemelson, col. 5, lines 53 – 56). This parameter is not of concern to the accumulation sensor of the invention, but rather, what is of concern is the vapor pressure of the source chemical. Thus, the accumulation sensor is located out of line-of-sight of the chemical source, and the temperature of the accumulation sensor is kept at a temperature substantially equal to the condensation temperature of the chemical source at the desired vapor pressure (both of these limitations are in claim 1). These two limitations result in the accumulation on the accumulation sensor being an accurate measure of any excess vapor pressure of the source (see p. 33, lines 15 – 18, of the present application). The condensation (positive accumulation sensed) or vaporization (negative accumulation sensed) on the accumulation sensor is a very sensitive indicator of the deviation of chemical vapor pressure from a set point. While it might be thought that a pressure sensor could be used to achieve the same goal, in most cases chemical vapor sources are being used with an inert (non-condensable) carrier gas that is fed into the source through a carrier gas inlet valve and emerges seeded with chemical out of the source outlet valve. In these cases,

the presence of carrier gas precludes the use of pressure sensors to control the vapor pressure of the chemical, as this vapor pressure is only a partial pressure of the total pressure (see, i.e., disclosure col. 37, lines 1 – 18). Seeding a non-condensable carrier gas with vapor from a liquid or solid chemical is known in the art as an insurmountable task that this disclosure solves for the first time. This is covered by the method claim 8.

In Lemelson, there is no hint of a solution to any of the problems that the current disclosure describes and solves. This disclosure describes a novel application of accumulation sensors to control vapor pressure in a vapor source. In contrast, Lemelson is using the sensor for the traditional monitoring and control of deposition.

Turning to the specific limitations of the claims, as argued above, Lemelson actually does not disclose any of the limitations of claim 1. Lemelson is a world apart from claim 1. We have amended claim 1 to highlight the distinctions mentioned above. Thus, under the MPEP and applicable case law, claim 1 is patentable over Lemelson.

Claim 3 describes the apparatus used to control the total pressure of chemical vapor plus carrier gas inside the source. Since the vapor pressure of the chemical is controlled by the accumulation sensor method and apparatus taught in the present disclosure, controlling the total pressure with a pressure gauge to control the addition of the non-condensable carrier gas allows one to precisely control the mixture of carrier gas and chemical mixture (see, i.e., disclosure col. 37, lines 1 – 18). Claim 3 has been amended to make the distinction from conventional prior art more crisp. Therefore, the apparatus as recited in the claim is entirely novel. Therefore, claim 3 is patentable.

Claim 2 has been rejected under 35 USC 103(a) as being unpatentable over Lemelson in view of Hillman (US Patent No. 6,409,837, hereinafter "Hillman"). This rejection is respectfully traversed. Hillman describes a liquid injection source wherein a chemical from a liquid source is injected into a process chamber. This is an entirely different chemical source approach, and naturally there is no similarity in the end-product, the apparatus, or method between Hillman and the current disclosure. Claim 2 has been amended to make the distinction from conventional prior art more crisp. Therefore, both claims 1 and 2 are patentable over Hillman in combination with Lemelson. Claim 2

also depends on claim 1, which is patentable; therefore, claim 2 is also patentable. *In re Fine*, 5 USPQ 2d 1596, 1600 (Fed. Cir. 1988).

Claims 4 and 5 have been rejected under 35 USC 103(a) as being unpatentable over Lemelson in view of Ratner et al. (US Patent No. 5,153,072, hereinafter "Ratner"). This rejection is respectfully traversed. While Ratner discloses an etch, the etch is performed after the deposition gases are evacuated from the chamber (col. 14, lines 22 – 26). There is logically no sensing of accumulation when the deposition chemicals are evacuated. Thus, Ratner does not make claim 4 obvious. With respect to claim 5, neither reference discloses any of the etching agents claimed. Further, claim 4 depends on claim 1 and claim 5 depends on claim 4, and for at least this reason claims 4 and 5 are patentable. Claim 4 teaches control of vapor pressure of a chemical that is generated by etching metal targets with etching gas (see disclosure, i.e., col. 37, line 19 – col. 38, line 10). In this case, the condensable chemical is created "on the spot"; and the disclosure describes the apparatus and method that control the generation of this chemical to a desired pressure. There is nothing of the application, apparatus, or method in the Ratner patent or the combination of Lemelson and Ratner. The combination of Ratner and Lemelson does not teach a chemical source and does not even relate to controlling vapor pressure of chemical in a vapor source. Claim 4 was further amended to make the distinction between the claims and Lemelson and Ratner more crisp. Claim 4, therefore, is patentable; and claim 5, being derived from claim 4, is patentable as well.

Claims 6 and 7 have been rejected under 35 USC 103(a) as being unpatentable over Lemelson in view of Endo et al. (US Patent Application Publication No. 2002/0172768, hereinafter "Endo"). This rejection is respectfully traversed. First, as discussed above, claim 1 is patentable over Lemelson. Second, with respect to claim 6, neither the Office Action nor the cited references mention a pressure controlled reservoir and the shut-off valve between the reservoir and the deposition chamber. With respect to claim 7, neither the Office Action nor the cited references mention the capacity of the deposition chamber. Thus, claims 6 and 7 are patentable. Further, claims 6 and 7 both depend on claim 1, which is patentable, and for this reason also are patentable over the cited references.

Claims 8, 10, and 12 have been rejected under 35 USC 103(a) as being unpatentable over Lemelson in view of Sherman (US Patent No. 6,342,277, hereinafter "Sherman") and Ratner. This rejection is respectfully traversed. As mentioned above, not a single one of the limitations of claim 8 are in any of the cited references. Sherman is using the vapor pressure from a source which is known in the art. However, as explained above in answering the rejection of claims 1 and 3, the problem of these conventional sources is controlling vapor pressure at a desired set-point during and after substantial chemical draw. Sherman does not even refer to that problem and does not teach any solution. As described in the answer to the rejection of claims 1 and 3 above, the Lemelson patent relates to controlling deposition not a chemical source. Ratner also relates to deposition wherein the process for growing the film on the substrates includes condensation of polymeric vapor on the substrates, and the deposition on the deposition-chamber walls is prevented by keeping the walls hotter than the substrates to prevent that condensation. Claims 8, 10, and 12 refer to the method of using the apparatus described in claims 1 – 7 and using the invention to control the vapor pressure, sometimes referred to as the "partial pressure", of a chemical within a source that has also a non-condensable carrier gas, such as an inert gas (see disclosure, i.e., col. 37, lines 1 – 18). It is a completely novel capability that could not be achieved without the apparatus methods described and claimed in this disclosure. Claim 8 has been amended to make the distinction from prior art more crisp.

Claim 9 has been rejected under 35 USC 103(a) as being unpatentable over Lemelson in view of Sherman and Ratner, and further in view of Hillman. This rejection is respectfully traversed. Claim 9 depends on claim 8 and is patentable at least for that reason. As described above, there is no similarity between the combinations of all of the patents cited in the Office Action and the current disclosure.

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In view of the above amendments and remarks, Applicant believes the pending application is in condition for allowance. A Request For Continued Examination and the appropriate fee are attached to this paper. If any additional fee is due, please charge our Deposit Account No. 50-1848, under Order No. 020008.0111PTUS from which the undersigned is authorized to draw.

Respectfully submitted,
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